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Trend Analysis of Death Rates in the State of Illinois, 1967-1975

Illinois Univ. at the Medical Center
Chicago

Prepared for

Health Effects Research Lab.
Research Triangle Park, NC

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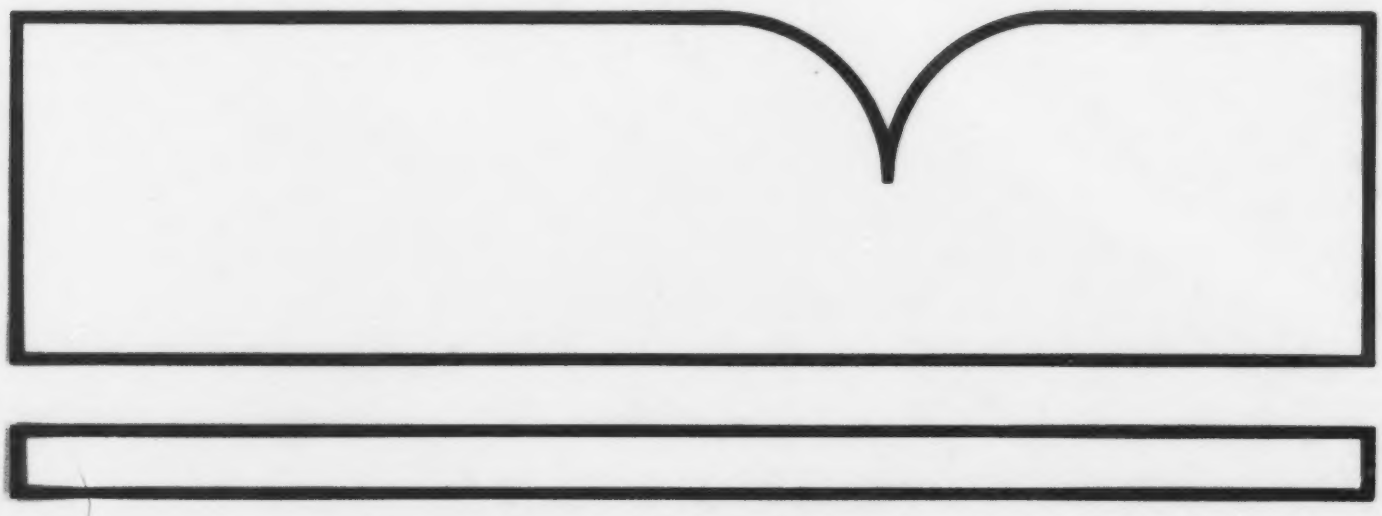

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The second analysis is to examine mortality and air pollution trends in some major cities to see if both mortality and air pollution have been declining in these cities or if such trends can be observed only in Chicago. There were no common patterns of mortality and air pollution among those cities over the recent nine years; however, a considerable decrease in both mortality (all causes and heart disease) and air pollution (total suspended particulate) was observed in all cities.

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TREND ANALYSIS OF DEATH RATES IN THE STATE OF ILLINOIS, 1967-1975

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FOREWARD

The many benefits of our modern, developing, industrial society are accompanied by certain hazards. Careful assessment of the relative risk of existing and new man-made environmental hazards is necessary for the establishment of sound regulatory policy. These regulations serve to enhance the quality of our environment in order to promote the public health and welfare and the productive capacity of our Nation's population.

The Health Effects Research Laboratory, Research Triangle Park, conducts a coordinated environmental health research program in toxicology, epidemiology, and clinical studies using human volunteer subjects. These studies address problems in air pollution, non-ionizing radiation, environmental carcinogenesis and the toxicology of pesticides as well as other chemical pollutants. The Laboratory participates in the development and revision of air quality criteria documents on pollutants for which national ambient air quality standards exist or are proposed, provides the data for registration of new pesticides or proposed suspension of those already in use, conducts research on hazardous and toxic materials, and is primarily responsible for providing the health basis for non-ionizing radiation standards. Direct support to the regulatory function of the Agency is provided in the form of expert testimony and preparation of affidavits as well as expert advice to the Administrator to assure the adequacy of health care and surveillance of persons having suffered imminent and substantial endangerment of their health.

This report summarizes mortality trends in the State of Illinois and major cities with trends of a few individual air pollutant concentrations during the nine year period, 1967-1975.

F. G. Hueter, Ph.D.
Director
Health Effects Research Laboratory

ABSTRACT

This report summarizes mortality trends in the State of Illinois and major cities with some air pollution trends during the nine year period, 1967-75.

To examine an overall mortality trend in Chicago, downstate Illinois and both combined or Illinois total, age-adjusted death rates were calculated. A declining trend was observed in death rates for all causes, heart disease, cerebrovascular disease, accidents, and pneumonia and influenza in all three groups over the nine year period. However, deaths from malignant neoplasms have encountered an increase over time in both Illinois total and downstate, with the exception of Chicago where cancer death rates were unchanged.

The second analysis is to examine mortality and air pollution trends in some major cities to see if both mortality and air pollution have been declining in these cities or if such trends can be observed only in Chicago. There were no common patterns of mortality and air pollution among those cities over the recent nine years; however, a considerable decrease in both mortality (all causes and heart disease) and air pollution (total suspended particulate) was observed in all cities.

This work was submitted in fulfillment of Contract No. 68-02-2492 by the University of Illinois of Public Health under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from February 15, 1976 till October 1, 1978, and which was completed as of March 8, 1979.

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The nation enjoyed an increasingly stable mortality decline during the 1970's with the lowest death rate achieved in 1975, reported Dorothy Rice, the Director of the National Center for Health Statistics.[1] Improvements were shown in the death rates from diabetes, hypertension and accidents, with the most dramatic changes of decrease noted from heart and cerebrovascular disease. However, the death rate from malignant neoplasms has continued to increase slightly.

Also vital statistics reports[2] from the State of Illinois show a consistent downward trend in mortality in Illinois from 1967 to 1975. Crude death rates reveal that heart disease, cerebrovascular disease, accidents, pneumonia and influenza, congenital anomalies, diabetes and all causes indeed are decreasing. Death rates from malignant neoplasms and homicides have increased, while emphysema has fluctuated from year to year.

In November, 1975, a recent mortality decline in the city of Chicago was publicized by one of the local newspapers.[3] The article stated that Jacob Dumelle, chairman of the Illinois Pollution Control Board, asked the U.S. Environmental Protection Agency to investigate if a recent mortality decline in Chicago was due to a recent decrease in air pollution. Accordingly, the task to investigate and answer this question was given to the School of Public Health at the University of Illinois through the contract from U.S. EPA.

Before examining the relationship between air pollution and mortality in Chicago, it is important to re-examine mortality trends in the State of Illinois and major cities including Chicago. This report summarizes such mortality trends as well as some air pollution trends in some cities in Illinois between 1967 and 1975.

To examine an overall mortality trend in Chicago, downstate Illinois and both combined or the entire state, age-adjusted death rates were calculated by using age-specific death rates from Vital Statistics Illinois[2] and annual population estimates from 1967 to 1975 which were provided by the Illinois

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1. "Mortality Decline Increasing," The Nation's Health, May 1977, p. 7.
2. Vital Statistics Illinois (Springfield: Illinois Department of Public Health, 1967-1975).
3. "Is lower death rate due to clean air?-Dumelle", The Chicago Tribune-November 3, 1975.

Department of Public Health. The 1970 census population of Illinois was used as a standard population. This direct standardization enables us to compare death rates between different population groups from year to year independently of the age composition of the population.

An examination of Figure 1 (with tabulated numbers to be located in the appendix, Table 1) comparing state-wide crude and age-adjusted death rates for all causes, 1967-1975, reveals a slight discrepancy in figures, but identifies a trend nevertheless. From now on, unless otherwise stated, the discussion will be limited to age-adjusted death rates only.

An overview of nine years within the total state of Illinois identifies a continued downward slope since 1968. Downstate trends maintain an equilibrium state after an initial high in 1968. The ensuing years after 1975 must be watched to determine whether the mortality rates in downstate Illinois would continue to be sporadic. The latter part of the decade found the mortality rates in Chicago to be haphazardly declining. However, since 1970, the death rates from all causes do appear to be on a steady decline.

The simple analysis of death rates from all causes within the state declares a trend, whether an increase or decrease, short term or long-term, as stated above. However, some additional insight is provided when the same age-adjusted death rates are examined by specific causation. Age-adjusted death rates from five major causes, that is, heart disease, malignant neoplasms, cerebrovascular disease, accidents and pneumonia and influenza are presented in Figure 2 (compiled rates, appendix, Table 2). Again ages were adjusted based on the 1970 population of Illinois.

Over the nine year period, 1967-1975, the death rate for heart disease accounted for the largest decrease of 74.8 deaths per 100,000 persons in Illinois total, to 369.7 from 444.5; in Chicago the decrease was 93.5 and downstate 58.8 deaths per 100,000 persons. Cerebrovascular disease decreased 19.7 in Illinois total, 20.5 in Chicago and 19.4 in downstate. Accidents and pneumonia and influenza also reported a decreasing trend, establishing a number of lives which have been saved over the past 9 year period. However, as reported above, and related in the nation's health statistics, deaths from malignant neoplasms have encountered an increase over time, with Illinois total yielding an increase of 7.3, with Chicago decreasing by 0.9 and downstate increasing by 12.8.

The second analysis is to examine mortality and air pollution trends in

some major cities in Illinois (e.g., Chicago, Joliet, Peoria, Rockford, Springfield and East Moline) to see if both mortality and air pollution have been declining in these cities or if such trends can be observed only in Chicago. Death rates are crude rates from Illinois Vital Statistics Reports,[2] and air pollution indices used are annual means of total suspended particulate (TSP) in $\mu g/m^3$ and sulfur dioxide (SO_2) in $\mu g/m^3$ obtained from the National Aerometric Data Bank, U.S. Environmental Protection Agency. It was necessary to use crude rates because of the lack of age-and sex-specific death rates from those cities in the reports from the State of Illinois. Unfortunately the State of Illinois was able to provide only the numbers of deaths by specific causation by age group (every five years), and not a total population distinguished by age. There is no tabulation of such figures by community, the smallest breakdown being county-wide. Therefore age-adjusted death rates were not to be compiled for this analysis.

Figure 3 displays an inter-city comparison of annual crude death rates, from all causes, 1967-1975, expanding the analysis done on a state-wide basis. From 1967 through 1973, there is no consistent pattern or trend among cities. However it is after that point a decrease in the mortality rate is discernable among all cities. To mirror the health status of these communities, TSP values, annual averages computed in $\mu g/m^3$, are depicted over the same nine year span in Figure 4. The former part of the time frame presents no perceptible trend; however, over the years, the quality of air has improved with an overall decrease in the ambient air level of total suspended particulate.

A more precise analysis between trends in death rates and specific air contaminant values is elaborated within each specific city in Figures 5-10. (Please note that all tabulated figures for each chart are found in the Appendix). It is important to note each community's size and type, with an insight to the availability of data when any inter-city comparison is attempted.

In 1970 the city of Chicago passed the Clean Air Ordinance which prohibited the use of coal as a residential heating fuel, plus banned leaf burning. From that point forward, Chicago has experienced a drop in ambient sulfur fumes by 75%, and airborne particulate levels have plummeted by 30%. At the same time, the city has experienced a decrease in total mortality with specific attention given to heart disease and respiratory disease as apparent in Figure 5. A possible correlation might exist between specific mortality and ambient air

pollution in conjuction with additional variables, not accounted for in this analysis.

Joliet is located in a south-western suburb of Chicago, population of 100,000, with industry providing most of the livelihood. Unfortunately, sulfur oxides are not measured adequately for sampling. However, total suspended particulates have been reduced by 50% over the past nine years. Figure 6 details that mortality rates from all causes, heart and respiratory diseases have shown a slight decrease over time, though the rates were subject to fluctuation during that time span.

Figure 7 describes Peoria, further to the west and again urban-industrialized though located in rural farmland. The city has not maintained an adequate monitoring system to observe sulfur dioxide; hence, only TSP levels are again cited. The general trend of paticulate pollution has decreased by 30% with a sudden upward swing in 1974. Total mortality, with specific attention to heart disease, has registered a slight decrease over time, though no pattern may be observed in regard to respiratory disease.

Rockford, the second largest city in the state of Illinois, has only values of TSP available for analysis, which when charted in Figure 8, describe a continued decent since 1970. The mortality rates from all causes and heart diseases have decreased, but marked with some fluctuation. In the latter portion of the study time frame, respiratory disease does have a marked decrease, which mirrors the decline of the air contaminant values.

Springfield, the capital of the state, also located in farmland has become a major metropolitan area. Again, sulfur dioxide data is inadequate and unavailable for commentary. Total suspended particulate has decreased by 20% in the time period, with respiratory diseases declining by a steady 40%. Figure 9 pinpoints that mortality from all causes, after a long increase, has declined since 1973, with heart disease mortality mirroring the same trend.

As the last of our respective communities, described in Figure 10, East Moline represents certain limitations due to the wide unavailability of both data sets. Vital Statistics are available only until 1973, while TSP has been monitored since 1972. All the communities selected for analysis were chosen on a basis of wanting to present a variety of unique situations and statistics comprising the state. Of course, primary consideration was given to those communities having data available to analyze. Unfortunately, East

Moline was unable to provide a complete data set from either source, causing a more severe limitation than use of only unadjusted data.

Although there were no common patterns of mortality and air pollution among those cities over the recent nine years, a considerable decrease in both mortality (all causes and heart disease) and air pollution (TSP) was observed in all cities (except East Moline). Since a death rate is influenced by many factors, we cannot pinpoint a proof of a relationship between mortality and air pollution even if they are declining in parallel. Factors which may affect mortality are (1) demographic (age, sex, race, urban-rural and migration), (2) socioeconomic (income, education, environmental living conditions and occupation), (3) personal (nutrition, medical care, smoking habits, exercise habits and genetic factors), and (4) environmental (air quality or air pollution, water quality, occupational exposure to toxic substances, and climate). An ideal study on the association between air pollution and mortality would control for all the factors listed above. However, such a study is not feasible at present because much of the data is not available, especially on personal factors, lacking a survey to follow up the family of the deceased. (Even with a survey, such past information is often quite limited and unreliable). Nonetheless, there is an urgent need to measure the strength of the relationship between air pollution and mortality; at present this can be accomplished only by using existing and limited information.

Chicago is probably a best area among the cities examined earlier to investigate the strength of the relationship between air pollution and mortality in detail because of its large population size, citywide coverage of ambient air monitoring systems, and possible population breakdowns into census tracts or community areas. Thus, a mortality study has been carried out to answer the question, "How much of the reduction in mortality is the result of lower concentration of the individual pollutants in the city of Chicago?" (See the U.S. EPA document; Model for Measuring the Health Impact From Changing Levels of Ambient Air Pollution: Mortality Study.).

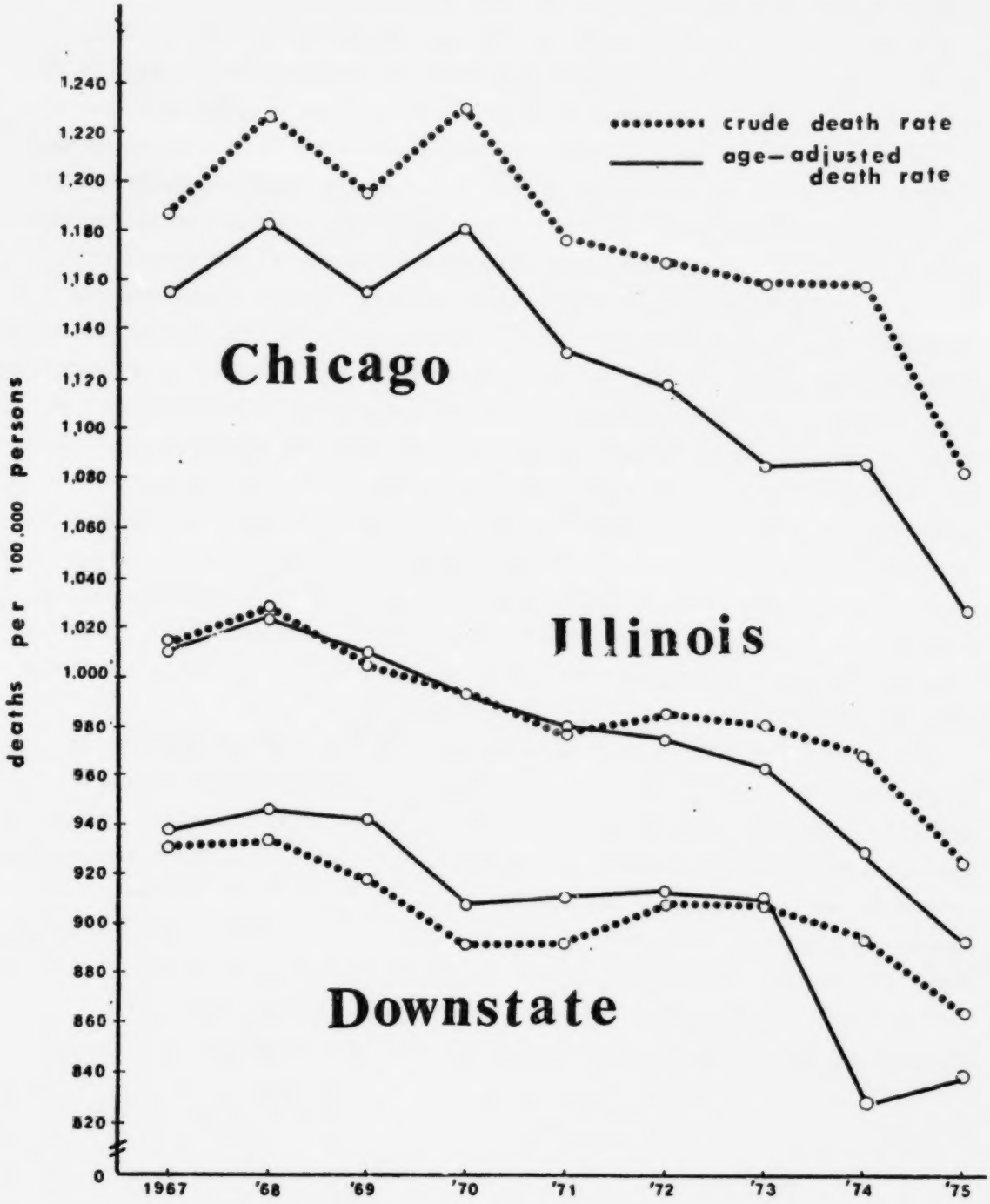


Figure 1. Crude death rates and age-adjusted death rates in Illinois, Chicago and Downstate from 1967 to 1975.

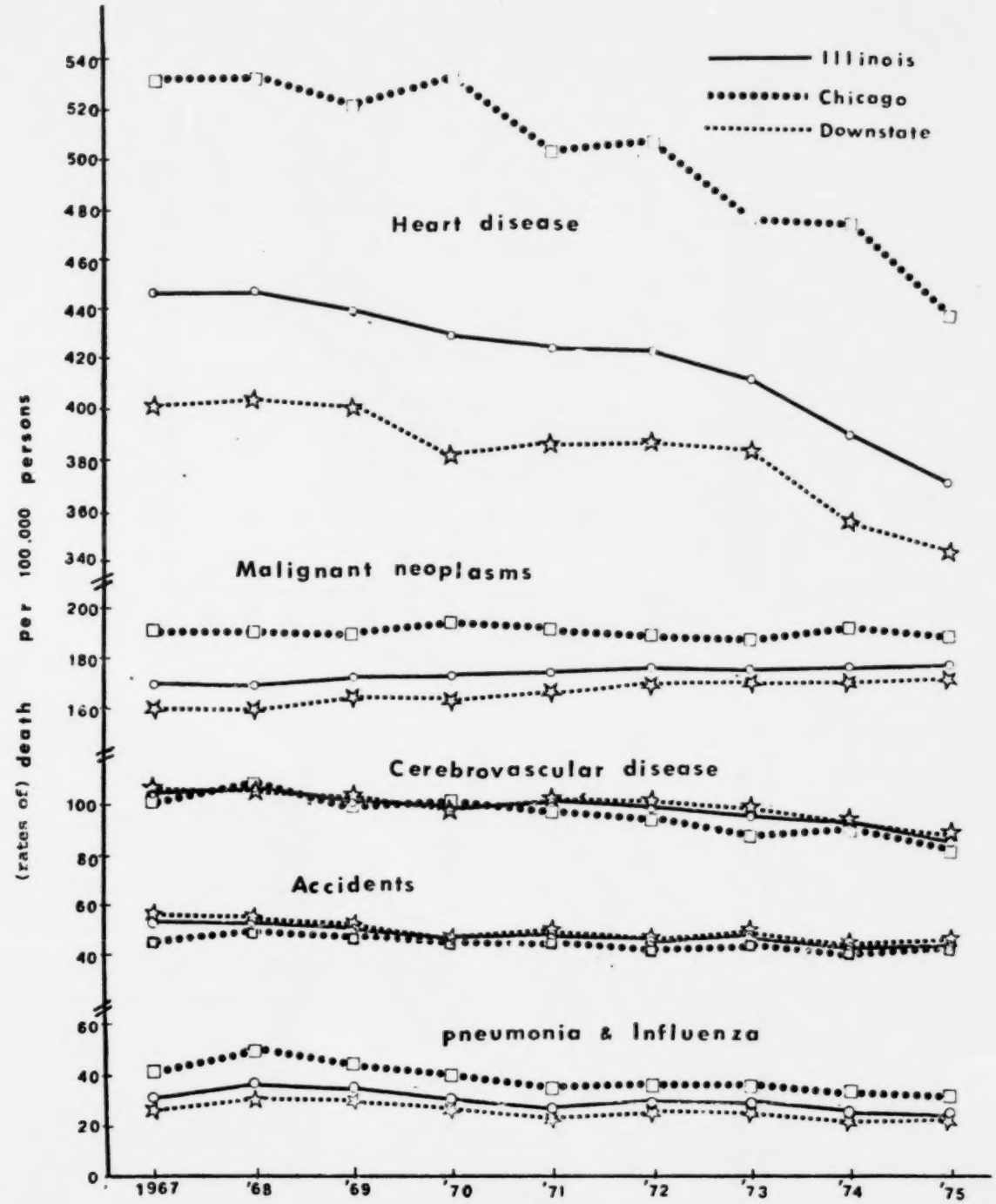


Figure 2. Age-Adjusted death rates by five major causes in Illinois, Chicago and Downstate from 1967 to 1975.

FIGURE 3

CRUDE DEATH RATE, PER 100,000 FROM ALL CAUSES IN 6 ILLINOIS CITIES, 1967-1975

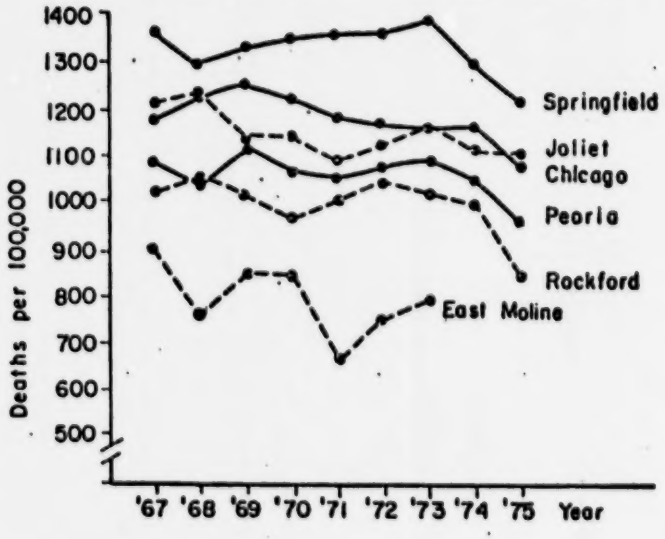


FIGURE 4

CITY-WIDE ANNUAL AVERAGE, TSP $\mu g/m^3$ AT 25°C 1967-1975, SELECT COMMUNITIES IN ILLINOIS

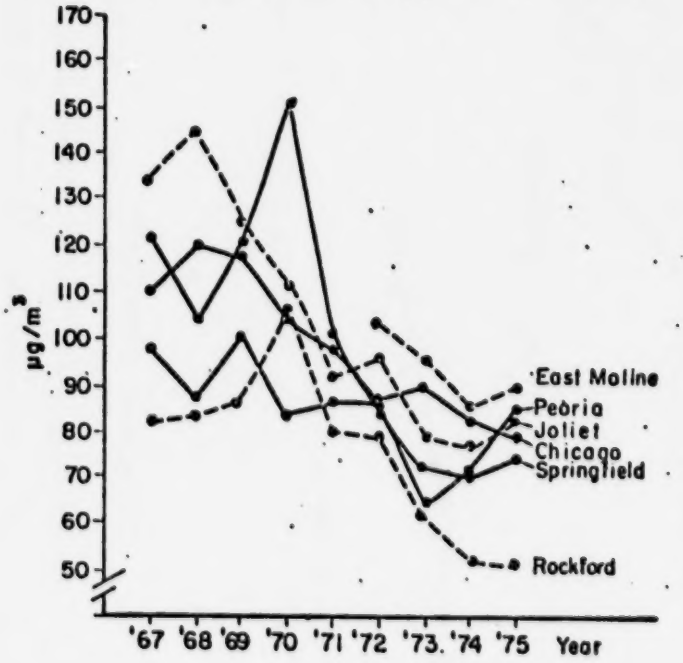


FIGURE 5

CRUDE DEATH RATES, PER 100,000, FOR 5 MAJOR CAUSES AND ANNUAL TSP MEANS, $\mu g/m^3$ FROM 1967-1975 IN CHICAGO, ILLINOIS

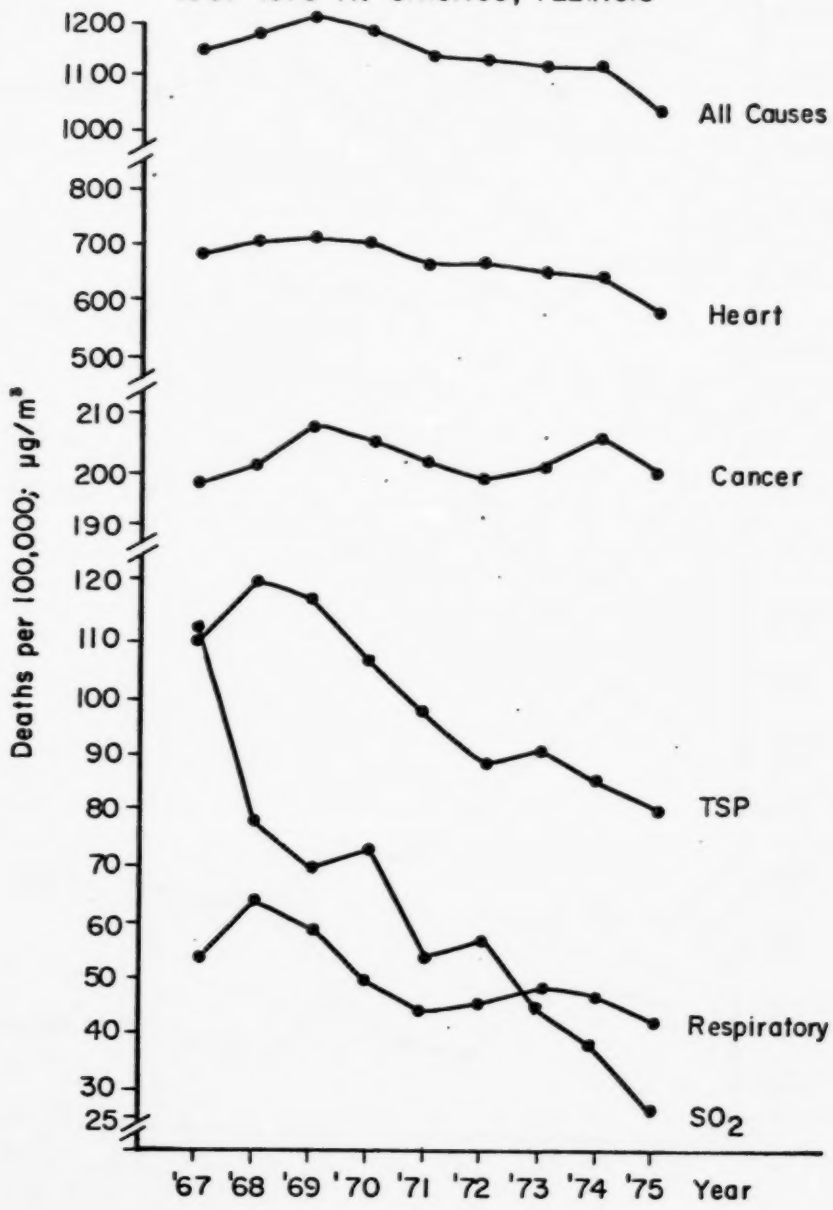


FIGURE 6

CRUDE DEATH RATES, PER 100,000, FOR 5 MAJOR CAUSES AND ANNUAL TSP MEANS, $\mu g/m^3$ FROM 1967-1975 IN JOLIET, ILLINOIS

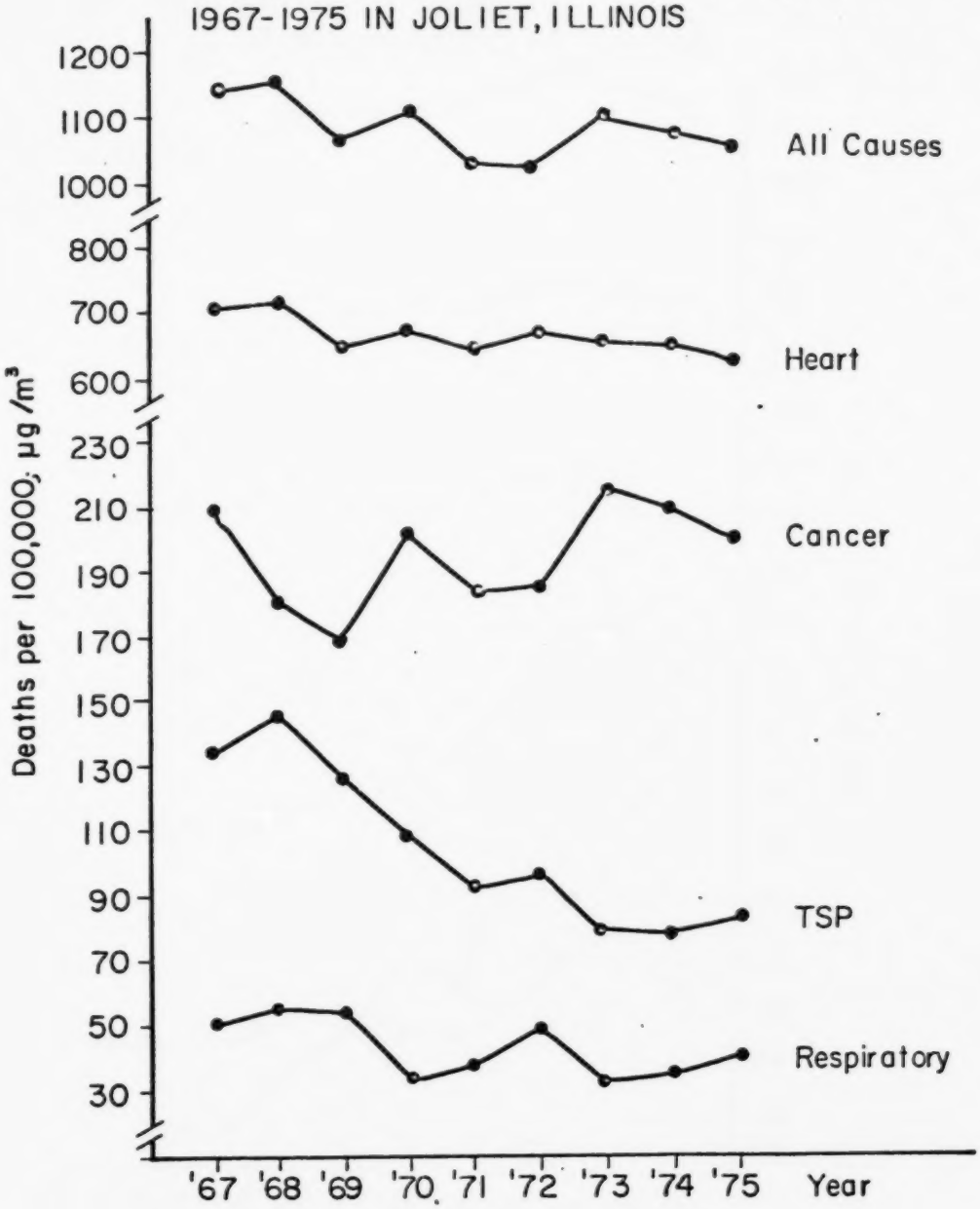


FIGURE 7

CRUDE DEATH RATES, PER 100,000, FOR 5 MAJOR CAUSES AND ANNUAL TSP MEANS, $\mu g/m^3$ FROM 1967-1975 IN PEORIA, ILLINOIS

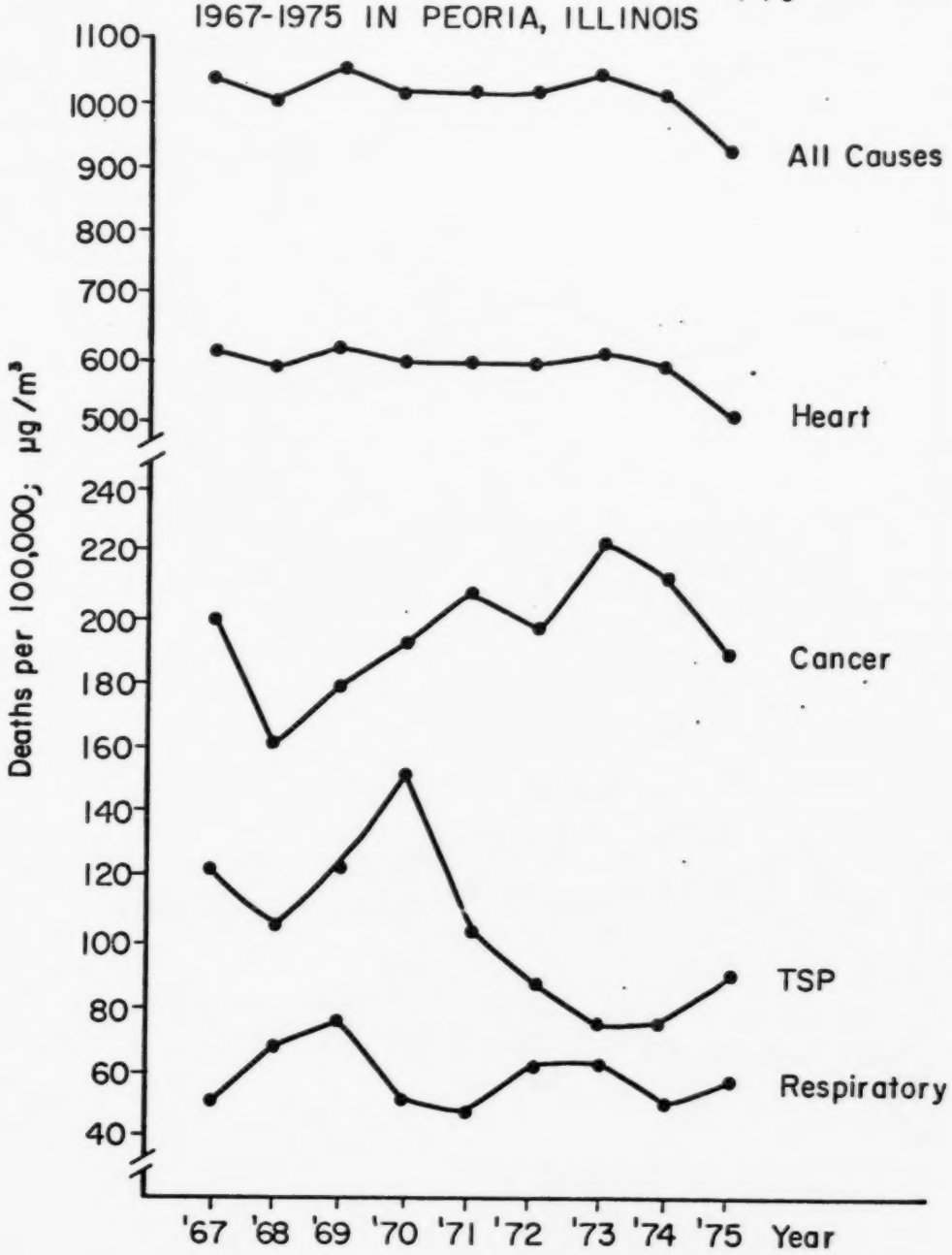


FIGURE 8

CRUDE DEATH RATES, PER 100,000, FOR 5 MAJOR CAUSES AND ANNUAL TSP MEANS, $\mu g/m^3$ FROM 1967-1975 IN ROCKFORD, ILLINOIS

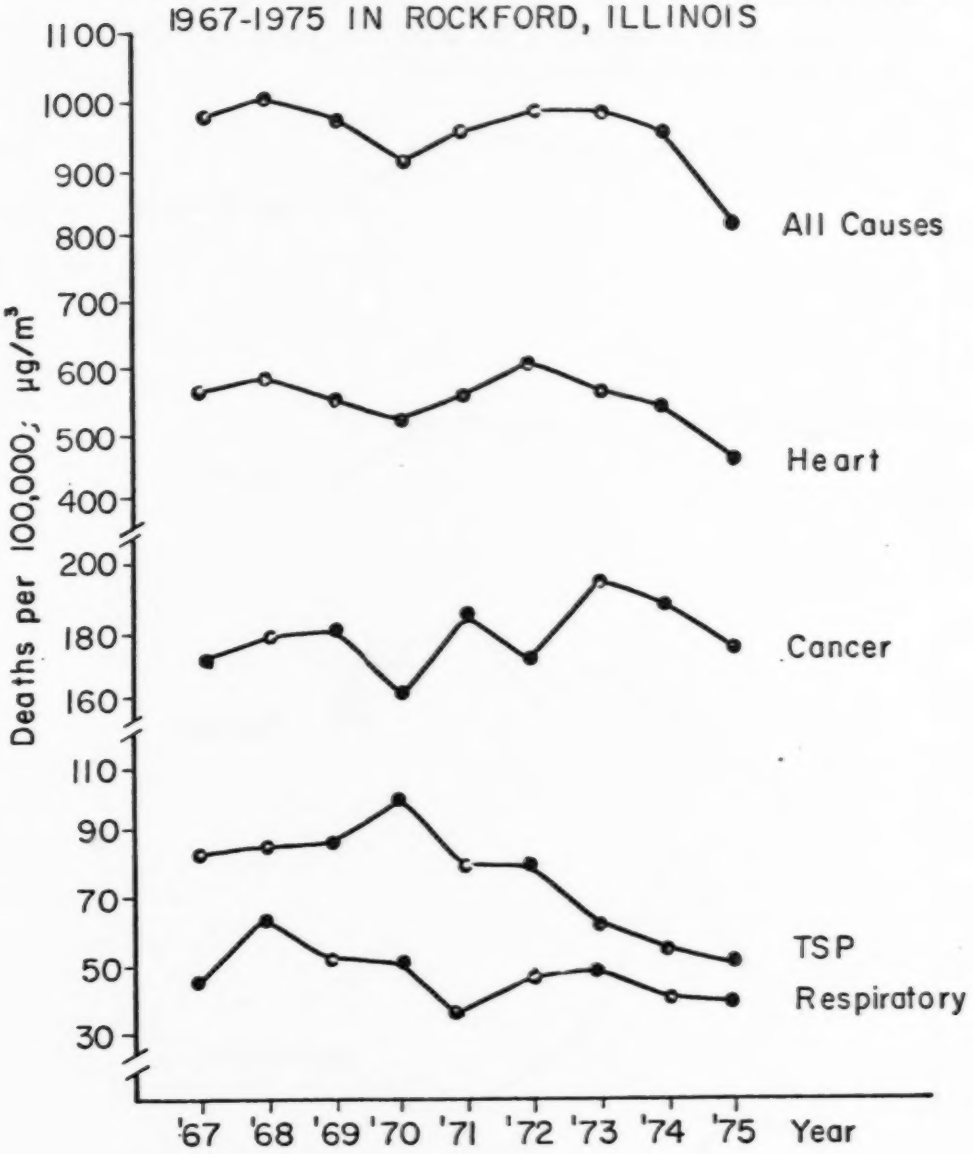


FIGURE 9

CRUDE DEATH RATES, PER 100,000, FOR 5 MAJOR CAUSES AND ANNUAL TSP MEANS, $\mu g/m^3$ FROM 1967-1975 IN SPRINGFIELD, ILLINOIS

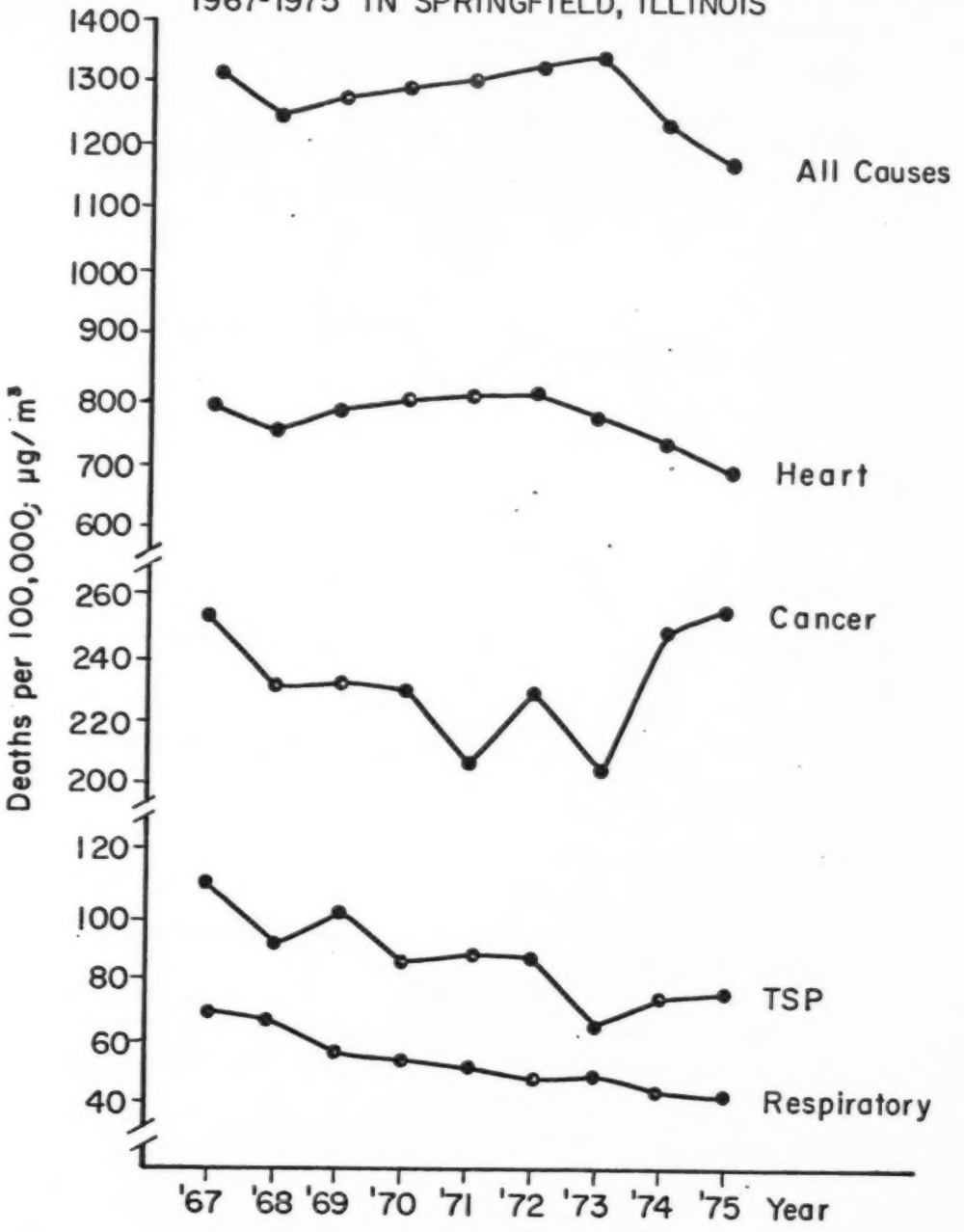
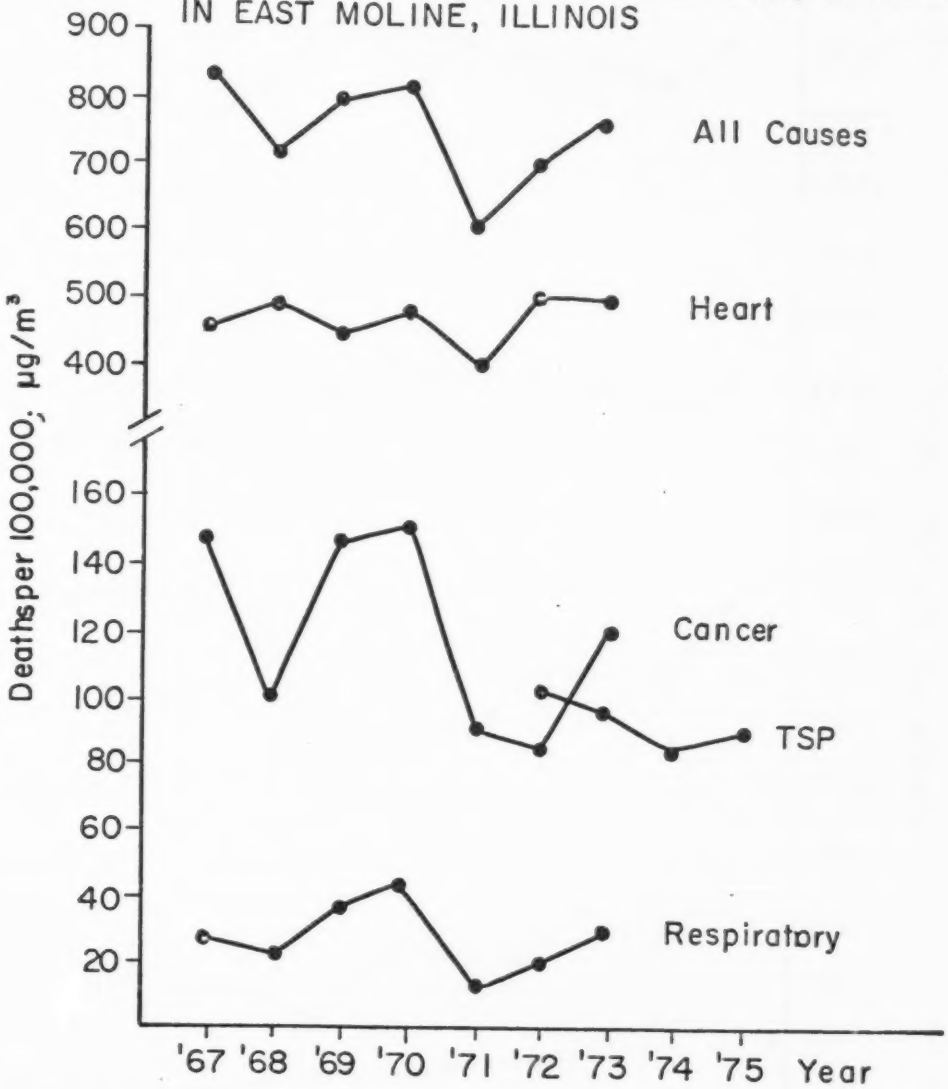


FIGURE 10

CRUDE DEATH RATES, PER 100,000 FOR 5 MAJOR CAUSES AND ANNUAL TSP MEANS, $\mu g/m^3$ FROM 1967-1975 IN EAST MOLINE, ILLINOIS



APPENDIX

Age-Adjusted and crude death rates, per 100,000 from 1967-1975 in Illinois, Downstate, Chicago and 5 Downstate communities from all causes, and Specific Causation.

TABLE 1

AGE-ADJUSTED DEATH RATES BY ALL CAUSES FOR ILLINOIS, CHICAGO AND DOWNSTATE
1965-1975 (per 100,000)

(Numbers in Script indicates crude death rates by cause.)

Year	Illinois	Chicago	Downstate
1967	1,012.36 *1,014.10*	1,155.65 *1,187.0*	937.95 *930.0*
1968	1,025.21 *1,027.2*	1,182.98 *1,226.0*	945.92 *932.8*
1969	1.010.52 *1,005.5*	1,155.08 *1,196.0*	940.65 *917.8*
1970	994.00 *994.0*	1,181.36 *1,129.9*	970.60 *891.5*
1971	980.34 *977.9*	1,131,90 *1,177.2*	911.08 *892.1*
1972	976.25 *986.3*	1,118.55 *1,168.2*	912.72 *980.3*
1973	963.01 *981.3*	1,085.00 *1,158.8*	910.12 *906.9*
1974	929.40 *969.1*	1,086.01 *1,158.2*	828.88 *894.5*
1975	893.91 *925.7*	1,028.04 *1,083.3*	838.69 *863.6*

TABLE 2
AGE-ADJUSTED DEATH RATES BY CAUSE, PER 100,000

		'67	'68	'69	'70	'71	'72	'73	'74	'75
Heart Disease	IL	444.5	446.1	439.5	429.1	422.7	432.2	410.9	389.3	369.7
	Chicago	530.9	531.9	521.4	531.7	503.1	506.6	476.1	473.8	437.4
	Downstate	400.4	403.1	400.2	381.4	385.5	385.9	381.9	354.2	341.6
Malignant Neoplasms	IL	169.2	169.1	171.5	172.3	173.8	174.8	174.8	176.3	176.5
	Chicago	189.6	190.1	188.9	193.9	191.0	188.7	186.9	192.5	188.7
	Downstate	158.6	158.4	162.8	162.1	165.9	168.6	169.5	169.4	171.4
Cerebrovascular Disease	IL	104.2	105.5	101.4	98.7	99.6	97.9	93.9	91.6	84.5
	Chicago	101.3	107.4	100.3	99.2	96.7	93.7	86.9	90.2	80.8
	Downstate	105.2	104.3	101.6	98.4	100.8	99.7	97.2	92.1	85.8
Accidents	IL	51.8	51.8	50.0	46.6	47.4	43.8	46.6	42.0	42.7
	Chicago	44.7	47.8	46.4	45.4	44.1	40.6	42.8	39.7	42.1
	Downstate	55.1	53.5	51.5	47.1	48.8	45.3	48.2	42.9	42.9
Pneumonia and Influenza	IL	31.3	37.4	34.8	31.1	26.9	29.5	29.4	25.8	25.4
	Chicago	41.5	50.5	45.1	39.8	34.6	36.5	35.8	34.3	31.4
	Downstate	25.9	30.7	29.8	27.1	23.3	26.4	26.4	22.3	23.0

Table 3

CRUDE DEATH RATES, PER 100,000 AND TSP AND SO_2 ANNUAL MEANS IN $\mu g/m^3$ IN CHICAGO

	1967	1968	1969	1970	1971	1972	1973	1974	1975
TSP	110	120	117	105	97	87.95	90.65	84.68	79.24
SO_2	112	77.3	69.3	72	53.3	56	45.3	37.3	26.7
Death Rate									
All	1142.2	1177.9	1204.3	1183.9	1132.7	1127.7	1115.1	1117.4	1040.0
Heart	682.4	700.8	712.1	701.0	667.9	672.1	674.8	645.7	586.7
Cancer	197.8	200.1	208.2	204.6	201.4	198.8	200.7	205.5	199.5
Respiratory	53.4	63.8	58.8	49.4	44.3	45.6	48.2	46.1	41.1

Table 4

CRUDE DEATH RATES PER 100,000 AND TSP ANNUAL MEANS IN $\mu g/m^3$ IN JOLIET, 1967-1975

	1967	1968	1969	1970	1971	1972	1973	1974	1975
TSP	134.6	146.7	126.9	111	92	96.5	79.14	77.28	83.04
SO_2	—	—	—	—	—	—	—	—	—
Death Rate									
All	1143.1	1156	1070	1101.0	1029.1	1029.1	1102.3	1074.7	1054.6
Heart	717.9	718.7	654.0	671.8	647.3	667.9	655.3	644.3	628.2
Cancer	208.6	181.3	169.2	202.8	183.3	184.3	214.6	208.9	200.5
Respiratory	50.8	56.0	53.4	33.6	36.7	48.0	23.8	35.5	38.0

Table 5

CRUDE DEATH RATES, PER 100,000 AND TSP ANNUAL MEANS IN $\mu g/m^3$ IN PEORIA

	1967	1968	1969	1970	1971	1972	1973	1974	1975
TSP	121.5	104	121.5	151	101	86	72.5	72.83	86.5
SO_2	—	—	—	—	—	—	—	—	—
Death Rate									
All	1038.3	1000.0	1056.5	1015.3	1015.7	1014.3	1046.3	1009.4	911.3
Heart	611.5	580.4	618.9	593.1	594.8	597.5	607.2	584.4	510.9
Cancer	195.4	162.3	179.8	190.6	206.1	195.0	223.1	210.5	187.4
Respiratory	49.1	67.4	74.8	50.4	47.9	61.5	61.3	48.3	54.4

Table 6

CRUDE DEATH RATES PER 100,000 AND TSP ANNUAL MEANS IN $\mu g/m^3$ IN ROCKFORD

	1967	1968	1969	1970	1971	1972	1973	1974	1975
TSP	83.25	84.25	87	107	80	80	62.5	52.25	52
SO_2	—	—	—	—	—	—	—	—	—
Death Rate									
All	977.8	1007.2	971.0	916.7	956.1	989.2	981.3	953.9	810.0
Heart	563.7	589.1	555.6	515.7	560.1	603.0	555.3	542.1	462.0
Cancer	171.1	179.7	181.8	163.5	186.5	172.2	196.2	189.2	174.0
Respiratory	45.9	64.5	51.1	49.5	34.5	47.3	49.6	40.1	38.0

Table 7

CRUDE DEATH RATES PER 100,000 AND TSP ANNUAL MEANS IN $\mu g/m^3$ IN SPRINGFIELD

	1967	1968	1969	1970	1971	1972	1973	1974	1975
TSP	3108	89.5	100	84	86	86	64.25	73.6	74
SO_2	—	—	—	—	—	—	—	—	—
Death Rate									
All	1310.8	1245.5	1270.3	1287.2	1289.9	1313.4	1337.6	1229.5	1166.5
Heart	785.4	754.4	788.7	801.1	807.6	809.1	769.2	730.6	681.1
Cancer	253.3	230.1	231.4	230.0	208.7	229.9	203.4	246.8	253.0
Respiratory	70.3	67.4	56.7	54.5	52.2	48.8	49.9	45.3	43.3

Table 8

CRUDE DEATH RATES PER 100,000 AND TSP ANNUAL MEANS IN $\mu g/m^3$ IN EAST MOLINE

	1967	1968	1969	1970	1971	1972	1973	1974	1975
TSP	—	—	—	—	—	104	96	86	89
SO_2	—	—	—	—	—	—	—	—	—
Death Rate									
All	845.8	719.1	805.8	811.3	612.5	708.2	765.5		
Heart	468.1	490.5	451.5	489.6	401.9	502.4	507.2	—	—
Cancer	146.9	100.0	150.5	153.6	90.9	86.1	119.6	—	—
Respiratory	26.6	23.8	38.9	43.2	14.4	19.1	28.8	—	—
								—	—